

USB for DSL Customer Premises Equipment

What DSL Service Providers Need to Know
About the New Universal Serial Bus DSL Modems



Learn about the basics of USB technology and see how USB modems can help increase customer satisfaction while lowering support costs for DSL service providers.

The Universal Serial Bus (USB) is an external bus specification for personal computers. Developed by Intel and six other PC and Telecom industry leaders, USB allows consumers to add peripherals to their PCs with true plug-and-play simplicity. Consumers simply plug the new device into their PC's external USB port, load a software driver, and they're ready to go. There's no need to open the computer to install the device and manually reconfigure system hardware and software. Consumers can connect up to 127 devices—from a mouse or joystick to a scanner or Zip* drive—or a modem.

Introduction: What Is USB and What Does It Mean for DSL Service Providers?

The USB definition was developed by Compaq, Digital Equipment Corp, IBM PC Co., Intel, Microsoft, NEC and Northern Telecom. Virtually all currently shipping PCs come with a USB port, and the Windows* 98, Windows 2000, Linux and Apple Macintosh* operating systems all support USB. A wide range of USB-supported peripheral devices are on the market and user demand for them is growing. DSL service providers will need an effective USB modem solution as they move forward.

USB can help DSL service providers reduce support costs and increase their return on investment. Since computers equipped with USB allow peripherals to automatically configure themselves as soon as they are physically attached, DSL providers who offer USB-compatible DSL modems as customer premises equipment (CPE) can eliminate the truck roll to the customer's premises. The simplicity of USB installation and usage significantly reduces technical support calls once the product is in the customer's hands.

Not surprisingly, consumers who've purchased USB-capable personal computers are eager to purchase and

use devices that support the new capability. By offering USB DSL modems, service providers can also satisfy the rising consumer demand for USB-compatible peripherals.

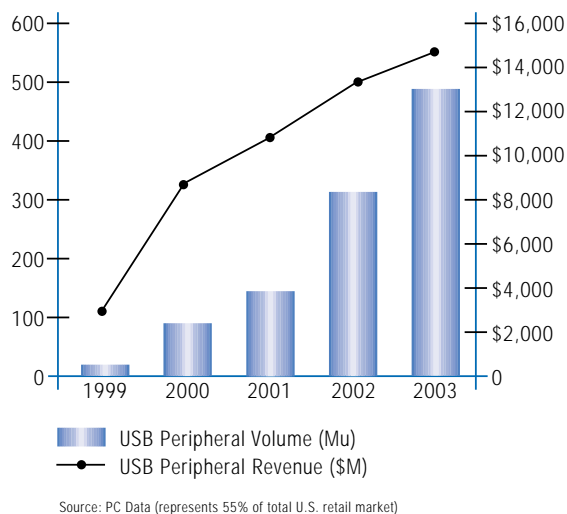


Figure 1. Strong growth of sales volumes and revenues from USB devices.

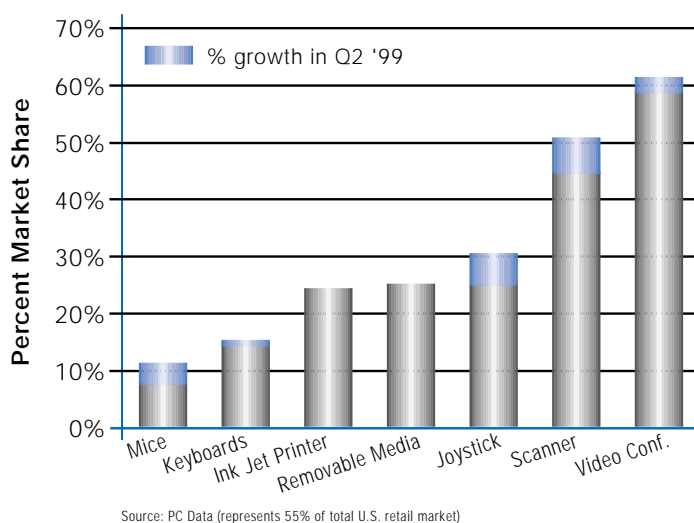


Figure 2. Percentage of USB in the U.S. Retail Market, June, 1999.

Rising Market Acceptance

USB peripheral availability and customer acceptance is growing rapidly. Recent studies show that both the volume of USB peripherals sold and the market share for USB are increasing (Figures 1 and 2).

Accelerating DSL Deployment

DSL service providers have three primary types of customers (see Table 1). By making DSL modems easier to install and use, USB technology can accelerate DSL deployments among all three user types. USB DSL CPE is ideally suited for residential users since it is easy to install and configure and doesn't require the user to open his or her computer to install the modem. Power users, telecommuters, gamers and laptop users also benefit from the convenience of a USB solution. In fact, any consumer whose PC and operating system support USB is likely to prefer USB-compatible peripherals and devices wherever possible.

Class of User	User Profile
Residential users	<ul style="list-style-type: none"> ■ Non-technical users—"moms and pops," grandparents, Internet "newbies" looking for a true broadband Internet experience. ■ Want a simple solution for a single computer. ■ Generally request the lower speed services, typically 256Kbps-2Mbps.
Power users/Gamers/Telecommuters	<ul style="list-style-type: none"> ■ Technical or more sophisticated users. ■ Want high performance DSL for home use for gaming and telecommuting. ■ High percentage have more than one computer or a LAN in the home.
SOHO, Small Business, and Enterprise Branch Office users	<ul style="list-style-type: none"> ■ Typically have several computers on a LAN in a small or home based business. ■ Require more advanced networking capabilities such as routing, bridging and multiple IP accounts.

Table 1. CPE User Profiles

Legacy-Free PCs

Another factor spurring the popularity of USB is that many PC manufacturers are introducing “legacy-free” systems, such as the iPaq* computer from Compaq. These PCs use USB to replace serial and parallel ports, as well as PS/2 keyboard and mouse ports. In fact, most legacy-free systems also do not have PCI slots for expansion—they use USB.

Legacy-free computers are less expensive to manufacture and support. They will become ubiquitous in the consumer market over the next several years—and a large and important part of the DSL service lifecycle.

USB 2.0

The specification for USB 2.0 has recently been finalized, adding further momentum to the USB bandwagon. USB 2.0 extends the speed of the peripheral-to-PC connection from 12 Mbps for USB 1.1 to as much as 480 Mbps—40 times faster than USB 1.1. The higher bandwidth will support the most demanding PC user applications, such as digital image creation and web publishing, and most importantly, high bandwidth USB broadband access devices. USB

2.0 is designed to support current USB peripherals, so consumers will continue to be able to use the USB devices they already have.

USB 2.0 was developed by the USB 2.0 Promoter Group, consisting of Compaq, Hewlett-Packard, Intel, Lucent, Microsoft, NEC and Philips Semiconductor. The new high bandwidth USB 2.0 standard is the technical launch pad for products with more functionality, including higher resolution video conferencing cameras, next-generation scanners and printers, secondary storage and faster broadband Internet devices such as full-rate DSL modems.

The first USB 2.0-enabled systems and peripherals are expected to be in stores and available online for the holiday 2000 shopping season. Broad availability of USB 2.0 in the PC platform is expected in 2001, with a wide variety of USB peripherals becoming available in the latter part of 2001.

Basics of USB Technology

USB has both hardware and software components that must work well together to provide a complete solution.

Hardware Elements

Hardware elements include the USB host controller chip in the PC and a USB slave controller chip in the USB peripheral.

The USB host controller chip is generally integrated in to the computer's chipset. USB host controllers follow one of two standards:

- The Universal Host Controller Interface (UHCI) standard is found in about 90% of PCs in the market today.
- The Open Host Controller Interface (OHCI) is used in the remaining systems—generally value PCs priced below \$1,000.

Intel, as a primary promoter of USB, originally released USB in the 82371SB (PIIX3) PCI ISA IDE Xcelerator, a portion of the Intel Motherboard Chipset. That implementation and those that followed it are UHCI compliant.

The USB slave controller chip for the USB peripheral (such as the DSL modem) is embedded in the USB peripheral device and is the endpoint of the USB data link.

Software Support

The software portion of USB is implemented in the computer operating system. The operating system is a major determinant of USB throughput. That's because each OS implements the USB controller software differently, and these differences can dramatically affect performance. As a rule of thumb, the newer the OS, the faster and more smoothly the USB bus will perform.

As the various operating systems evolve, their USB support continues to improve. Table 2 summarizes USB support in the most prevalent computer operating systems.

Intel: Leading the Way in USB and DSL Modems

Intel was a leader in the development of the USB specification and products, and continues to play an important role in the ongoing development of USB. Intel worked with other PC and telecom industry leaders to define, write, evangelize and produce reference chipsets, software, and device support to kick-start the industry.

Intel has led all USB initiatives up to and including USB 2.0. In fact, Intel Desktop Products Group Vice President Pat Gelsinger himself announced the new USB 2.0 specification in his keynote

speech at the Windows Hardware Engineering Conference (WinHEC) on April 17, 2000.

As a leading provider of DSL customer premises equipment, Intel provides a USB 1.1 compliant DSL modem—the Intel® PRO/DSL 3100 Modem. The PRO/DSL 3100 Modem offers three key features that make it a stand-out among USB-compliant DSL CPE:

- Good bus citizenship
- Powered by the USB bus
- Advanced power management for mobile PCs

Operating System	USB Support	Details
Windows* 95	Mixed	The original Windows 95 release did not support USB. Operating System Release 2 (OSR2 or Windows 95b) offered limited USB support, generally used only for low speed devices. Even current drivers are inadequate for high-speed devices.
Windows NT*	No	Windows NT does not support USB. Microsoft has not announced plans to support USB natively in this operating system.
Windows 98	Yes	Windows 98 was the first OS to support USB natively. Since its release, the number of USB peripherals has jumped dramatically. An upgrade to the USB support introduced with Windows 98 Second Edition (SE) improves overall data throughput, but it doesn't truly support high-speed devices such as a Full Rate DSL Modem.
Windows 2000	Yes	Windows 2000 was designed from the start to support USB., and a number of vendors, including Intel, are providing DSL modem drivers for Windows 2000.
Linux	Mixed	Linux support for USB is classified as "Experimental" for kernel versions through 2.2. While there are some simple drivers, mice, and other devices, a complex modem driver (e.g., other than AC97) has yet to materialize. However, the Linux community is very actively working on USB support, and the "Experimental" tag will disappear as of the next stable kernel release, 2.4 (stable releases have even minor numbers).
Apple Macintosh*	Yes	The Apple Macintosh product family natively supports USB. The newer iMac* computers rely on USB for all external peripherals.

Table 2. Operating System Support for USB

Good USB Bus Citizenship

USB is evolving from a little used, low speed connector for keyboards and mice to a standard high speed connection for digital video cameras and DSL modems. Most USB devices fall into one of two basic classes:

- Low speed devices such as mice, keyboards and game controllers
- High speed devices such as scanners, cameras, printers, CD-ROM drives, DVD drives, wired and wireless networking and ADSL modems.

These different classes of USB devices have different bus utilization requirements. To meet these varying requirements, the USB bus provides two data transfer modes:

- In **bulk mode**, devices share the bus by dynamically requesting bandwidth and releasing it when through.
- In **isochronous mode**, devices reserve a fixed amount of bandwidth at installation time.

Most CPE vendors implement USB isochronous mode drivers for their USB DSL modems. This is because the ATM layer of DSL assumes an always available, fixed bandwidth

connection to transfer cells and isochronous mode reserves the necessary bandwidth to do that. However, there's a deadly drawback to this approach: when the DSL modem reserves a large, fixed pipe, then other peripherals can't communicate to the computer on the USB bus. Imagine the customers' surprise when they install their isochronous mode DSL modem and suddenly find they can no longer use their digital camera, keyboard, mouse or scanner.

Intel avoids this scenario by implementing bulk mode drivers for its PRO/DSL 3100 Modem. Intel's focus on good USB citizenship has other consumer benefits as well. Since USB is relatively new technology, computer manufacturers and operating system vendors are still coming up to speed on the standard and are in the process of improving their support for USB. By implementing bulk mode drivers with a lower requested bandwidth, Intel's USB modem provides consistent performance characteristics across a very broad range of USB hardware and operating system implementations.

The Intel PRO/DSL 3100 Modem, with its more consistent bulk mode drivers, gives DSL service providers a more predictable USB modem deployment scenario and helps reduce support costs. It also provides consumers with more consistent performance, thus reducing performance fluctuations that consumers could incorrectly attribute to the DSL service itself.

Powered by the USB Bus

The Intel PRO/DSL 3100 Modem is bus powered, eliminating the need for external or internal power supplies. This dramatically increases usability, because it does away with the need to place the modem close to an AC power supply. It also reduces the country-specific issues involved with external power supplies. And, it greatly increases reliability of the modem, which helps to increase the DSL service provider's ROI and reduce long-term support costs.

Laptop DSL users will also appreciate that they don't need to pack yet another heavy power brick and cable in their bags.

The rapid market acceptance of USB technology means that DSL service providers must plan now to offer their customers a robust USB DSL modem solution. The Intel PRO/DSL 3100 Modem offers consumers exceptional ease of use and simple, do-it-yourself installation that can help service providers reduce support costs and improve ROI. The modem's combination of performance, stability, good USB citizenship and advanced features make it an outstanding choice for DSL CPE.

Advanced Power Management for Mobile PCs

The Intel® PRO/DSL 3100 Modem supports USB power management, which greatly reduces battery drain on mobile laptop computers when they're in standby or sleep mode. This is an important consideration because the likely laptop consumers for DSL will have advanced, high performance components such as large LCD screens, DVD drives, and faster processors which all contribute to increased battery usage.

For more information

To get more information on the Intel PRO/DSL 3100 Modem and other Intel DSL CPE modems, please visit <http://www.intel.com/home/dsl>.

For information on Intel and Industry Leaders' ongoing work in USB development, visit: <http://developer.intel.com/technology/usb>.

Copies of documents which have an ordering number and are referenced in this document, or other Intel literature, may be obtained by calling 1-800-548-4725 or by visiting Intel's web site at <http://www.intel.com>

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